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I CLAIM:

- 1 1. A logic tree branch for steering electromagnetic energy comprising anactive
- 2 element for directing said electromagnetic energy into one of first and second paths
- 3 and a passive element disposed in said second path for directing said electromagnetic
- 4 energy into a path parallel to said first path when said electromagnetic energy is
- 5 directed into said second path.
- 2. A logic tree branch according to claim 1 further including a source of said
- 2 electromagnetic energy having a given wavelength and circular polarization coupled to
- 3 said active element.
- 1 3. A logic tree branch according to claim 2 wherein said active element includes an
- 2 element transmissive to said given polarization and wavelength and reflective to said
- 3 given wavelength and a polarization opposite to said given polarization.
- 1 4. A logic tree branch according to claim 2 wherein said passive element includes an
- 2 element reflective to said given wavelength and a polarization opposite to said given
- 3 polarization.
- 1 5. A logic tree branch according to claim 2 wherein said active element includes
- 2 phase shifter means disposed between said source of electromagnetic energy and said
- 3 active element.
- 1 6. A logic tree branch according to claim 2 wherein said active element includes an
- 2 element made of cholesteric liquid crystal material.
- 1 7. A logic tree branch according to claim 2 wherein said passive element includes an
- 2 element made of cholesteric liquid crystal material.

- 1 8. A logic tree branch according to claim 2 further including a programmable pulse
- 2 of source connected to said active element.
- 1 9. A logic tree branch according to claim 2 further including means connected to
- 2 said source of electromagnetic energy for modulating said source.
- 1 10. A logic tree branch according to claim 5 wherein said phase shifter means ---
- 2 includes a phase shifting material responsive to different potential levels for switching
- 3 said phase shifting material between states which provide electromagnetic energy
- 4 having said given polarization and said opposite polarization.
- 1 11. A logic tree branch according to claim 5 wherein said phase shifting means
- 2 further includes electrode means for applying said different potential levels to said
- 3 phase shifter material.
- 1 12. A logic tree for steering electromagnetic energy comprising a plurality of stages,
- 2 the first of said stages including a branch for directing said energy to a similar branch
- 3 in each succeeding stage, each of said stages containing 2^{n-1} branches where n is the
- 4 stage number.
- 1 13. A logic tree according to claim 12 wherein each of said branches includes an
- 2 active element for directing said electromagnetic energy into one of first and second
- 3 paths and a passive element disposed in said second path for directing said
- 4 electromagnetic energy into a path parallel to said first path when said energy is
- 5 directed into said second path.
- 1 14. A logic tree according to claim 13 further including a source of said
- 2 electromagnetic energy having a given wavelength and circular polarization coupled to
- 3 said active element of said first stage.

- 1 15. A logic tree according to claim 14 wherein said active element includes an
- 2 element transmissive to said given wavelength and circular polarization and reflective
- 3 to said given wavelength and to a circular polarization opposite to said given circular
- 4 polarization.
- 1 16. A logic tree according to claim 14 wherein said passive element includes an
- 2 element reflective to said given wavelength and a circular polarization opposite to said
- 3 given circular polarization.
- 1 17. A logic tree according to claim 14 wherein said active element includes phase
- 2 shifter means disposed in electromagnetically coupled relationship with said active
- 3 element.
- 1 18. A logic tree according to claim 14 wherein said active element includes an
- 2 element made of cholesteric liquid crystal material.
- 1 19. A logic tree according to claim 14 wherein said passive element includes an
- 2 element made of cholesteric liquid crystal material.
- 1 20. A logic tree according to claim 14 further including a programmable pulsed
- 2 source connected to said active element.
- 1 21. A logic tree according to claim 14 further including means connected to said
- 2 source of electromagnetic energy for modulating said source.
- 1 22. A logic tree according to claim 14 further including half-wave retarders disposed
- 2 in electromagnetically coupled relationship with selected of said active and passive
- 3 elements of the last stage of said plurality of stages to convert said electromagnetic
- 4 energy emanating from said active and passive elements to a single circular
- 5 polarization.

- 1 23. A logic tree according to claim 17 wherein said phase shifter means includes a
- 2 phase shifting material responsive to different potential levels for switching said phase
- 3 shifting material between states which switch incident electromagnetic energy between
- 4 said given polarization and said opposite polarization.
- 1 24. A logic tree according to claim 23 wherein said phase shifting means further
- 2 includes means for applying said different potential levels to said phase shifter
- . 3 material.
- 1 25. A flat panel logic tree display array for steering electromagnetic radiation
- 2 comprising a plurality of first logic trees each of said first logic trees having a plurality
- 3 of stages, a single input port, a plurality of output ports, and wherein said array has 2^m
- 4 $\times 2^n$ output ports and m and n are stage numbers.
- 1 26. An array according to claim 25 further including a plurality of sources of
- 2 electromagnetic radiation each electromagnetically coupled to said a single input port
- 3 of an associated first logic tree and having a given wavelength and circular
- 4 polarization.
- 1 27. An array according to claim 25 further including a second logic tree similar to
- 2 each of said plurality of first logic trees having a plurality of stages, a single input port
- and a plurality of output ports each of said output ports of said second logic tree being
- 4 connected to a different one of said input ports of said plurality of first logic trees.
- 1 28. An array according to claim 26 wherein the first stage of said plurality of stages
- 2 includes a branch for directing said radiation to a similar branch in each succeeding
- stage, each of said stages containing 2^{n-1} branches where n is the stage number.

- 1 29 An array according to claim 27 further including at least a single source of
- 2 electromagnetic radiation electromagnetically coupled to said single port of said
- 3 second logic tree.
- 1 30. An array according to claim 27 further including a half-wave retarder
- 2 electromagnetically coupled to selected ones of said output ports of said plurality of
- 3 first logic trees.
- 1 31. An array according to claim 27 further including a half-wave retarder
- 2 electromagnetically coupled to selected ones of said output ports of said plurality of
- 3 first logic trees.
- 1 32. An array according to claim 27 wherein said plurality of output ports of said
- 2 plurality of first logic trees are disposed in the form of a rectilinear array.
- 1 33. An array according to claim 27 wherein said plurality of first logic trees and said
- 2 second logic tree are disposed in a orthogonal relationship.
- 1 34. An array according to claim 27 wherein each of said plurality of first logic trees is
- 2 disposed in stacked relationship with others of said first logic trees.
- 1 35. An array according to claim 27 wherein said plurality of output ports of said
- 2 second logic tree are remote from each said single input port of said plurality of first
- 3 logic trees.
- 1 36. An array according to claim 27 further including at least a single source of
- 2 electromagnetic radiation optically coupled to said single input port of said second
- 3 logic tree and means connected to said at least a single source for modulating said at
- 4 least a single source of electromagnetic radiation..

- 1 37. An array according to claim 27 wherein the first stages of said plurality of stages
- 2 of said first logic trees and the first stage of said second logic tree include a branch for
- 3 directing said radiation to a similar branch in each succeeding stage, each of said
- 4 stages containing 2^{n-1} branches where n is the stage number.
- 1 38. An array according to claim 28 wherein each of said branches includes an active
- 2 element for directing said electromagnetic radiation into one of first and second paths
- 3 and a passive element disposed in said second path for directing said radiation into a
- 4 path parallel to said first path when said radiation is directed into said second path.
- 1 39. An array according to claim 28 wherein said active element includes an element
- 2 transmissive to said given wavelength and circular polarization and reflective to said
- 3 given wavelength and to a circular polarization opposite to said given circular
- 4 polarization.
- 1 40. An array according to claim 28 wherein said passive element includes an element
- 2 reflective to said given wavelength and a circular polarization opposite to said given
- 3 circular polarization.
- 1 41. An array according to claim 28 wherein said active element includes phase shifter
- 2 means disposed in electromagnetically coupled relationship with said active element.
- 1 42. An array according to claim 28 wherein said active element includes an element
- 2 made of cholesteric liquid crystal material.
- 1 43. An array according to claim 28 wherein said passive element includes an element
- 2 made of cholesteric liquid crystal material.
- 1 44. An array according to claim 28 further including a programmable pulsed source
- 2 connected to said active element.

- 1 45. An array according to claim 28 further including means connected to said source
- 2 of electromagnetic radiation for modulating said source.
- 1 46. An array according to claim 28 further including half wave retarders disposed in
- 2 electromagnetically coupled relationship with selected of said active and passive
- 3 elements of the last stage of said plurality of stages to convert said electromagnetic
- 4 energy emanating from said active and passive elements to a single circular
- 5 polarization.
- 1 47. An array according to claim 37 wherein each of said branches of said first and
- 2 second logic trees includes an active element for directing said electromagnetic
- 3 radiation into one of first and second paths and a passive element disposed in said
- 4 second path for directing said radiation into a path parallel to said first path when said
- 5 radiation is directed into a first path.
- 1 48. An array according to claim 37 wherein said active element includes an element
- 2 transmissive to said wavelength and circular polarization and reflective to said given
- 3 wavelength and to a circular polarization opposite to said given circular polarization.
- 1 49. An array according to claim 37 wherein said passive element includes an element
- 2 reflective to said given wavelength and a circular polarization opposite to said given
- 3 circular polarization.
- 1 50. An array according to claim 37 wherein said active element includes phase shifter
- 2 means disposed in electromagnetically coupled relationship with said active element.
- 1 51. An array according to claim 37 wherein said active element includes an element
- 2 made of cholesteric liquid crystal material.

- 1 52. An array according to claim 37 wherein said passive element includes an element
- 2 made of cholesteric liquid crystal material.
- 1 53. An array according to claim 37 further including a programmable pulsed source
- 2 connected to said active element.
- 1 54. An array according to claim 37 further including means connected to said source
- 2 of electromagnetic energy for modulating said source.
- 1 55. An array according to claim 37 further including half-wave retarders disposed in
- 2 electromagnetically coupled relationship with selected of said active and passive
- 3 elements to convert said electromagnetic energy of the last stage of said plurality of
- 4 stages to convert said electromagnetic energy emanating from said active and passive
- 5 elements to a single circular polarization.
- 1 56. An array according to claim 41 wherein said phase shifter means includes a phase
- 2 shifting material responsive to different potential levels for switching said phase
- 3 shifting material between states which switch incident electromagnetic radiation
- 4 between said given polarization and said opposite polarization.
- 1 57 An array according to claim 50 wherein said phase shifter means includes a phase
- 2 shifting material responsive to different potential levels for switching said phase
- 3 shifting material between states which switch incident electromagnetic energy between
- 4 said given polarization and said opposite polarization.
- 1 58. An array according to claim 56 wherein said phase shifting means further includes
- 2 means for applying said different potential levels to said phase shifter material.
- 1 59. An array according to claim 57 wherein said phase shifting means further includes
- 2 means for applying said different potential levels to said phase shifter material.

- 1 60. A method for fabricating an array comprising the steps of:
- 2 forming a plurality of insulating media having a plurality of wavelength and
- 3 polarizing elements embedded therein at an angle relative to the
- surfaces of said media such that the spacing between elements halves for each
- 5 different medium in said plurality of said media,
- forming a phase shifter arrangement such that a portions thereof of conductive
- 7 material are disposed on one of said surfaces of said media in registry with
- 8 every other element in each of said media and other portions of which of
- 9 conductive material are disposed on another of said surfaces overlapping all of
- said elements, and, a phase shifting material disposed over at least said every
- other element
- stacking said plurality of media such that the topmost insulating medium has two
- elements and each succeeding medium has twice as many elements as a
- preceding medium.
- 1 61. A method according to claim 60 wherein the steps of forming a plurality of
- 2 insulating media includes the steps of:
- 3 stacking alternating layers of an insulating material and a wavelength and
- 4 polarization sensitive material the thickness of said layers of insulating
- 5 material determining the spacing between said elements, and
- 6 slicing said layers at an angle to form said plurality of insulating media with
- 7 said elements embedded therein.

- 1 62. A method according to claim 60 wherein the steps of forming a phase shifter
- 2 arrangement include the steps of:
- depositing transparent, conductive layers on said surfaces of said insulating
- 4 media,
- forming said portions of said conductive material on said one of said surfaces of
- 6 each of said media by photolithography,
- 7 affixing a spacer of insulating material about the periphery of said one of said
- 8 surfaces of each of said media, and
- 9 introducing a phase shifting material over said one of said surfaces of each of said
- 10 media.
- 1 63. A method according to claim 60 further including the step of sealing the topmost
- 2 of said media with a layer of insulating material.
- 1 64. A method according to claim 60 wherein said insulating media are made of SiO_2 .
- 1 65. A method according to claim 60 wherein said insulating media are made of
- 2 optically transparent layers.
- 1 66. A method according to claim 60 wherein said elements are made of cholesteric
- 2 liquid crystal material.
- 1. 67. A method according to claim 60 wherein said angle is 45°.
- 1 68. A method according to claim 60 wherein said conductive material is indium tin
- 2 oxide.
- 1 69. A method according to claim 62 wherein said phase shifting material is in liquid
- 2 form.

- 1 70. A method according to claim 62 wherein said phase shifting material is a liquid
- 2 crystal.
- 1 71. A method according to claim 62 wherein said phase shifting material is a solid
- 2 state electro-optic material.